[10191/4227]

VALVE ACTUATOR FOR OPERATING A GAS EXCHANGE VALVE OF AN INTERNAL COMBUSTION ENGINE

Background Information

The present invention is directed to a valve actuator for operating a gas exchange valve of an internal combustion engine according to the definition of the species in Claim 1.

DE 10 116 218 A1 describes a valve actuator of this type, in which one stem end of the gas exchange valve is connected to a positioning piston of the valve actuator via at least two shell-shaped wedge pieces which enclose the stem end and are axially supported by the positioning piston, the radially outer peripheral surface of the wedge pieces having a conical shape and being enclosed by a conical clamping sleeve. The conical clamping sleeve has a radially inner peripheral surface, whose shape is complementary to the conical angle of the wedge pieces and which is axially clamped against the wedge pieces by a threaded connection formed on the wedge pieces. Due to the conical angle and thread on the wedge pieces, these are relatively complex components, which are very costly to manufacture.

Advantages of the Invention

According to the present invention, a threaded bolt, axially form-fittingly and rotatably connected to the wedge pieces, is provided for connecting the gas exchange valve to the valve actuator. The manufacturing complexity is considerably reduced due to the provision of the conical angle and threaded connection functions on separate components.

The measures recited in the dependent claims make advantageous improvements on and refinements of the device described in Claim 1 possible. Thus, according to a preferred embodiment, the wedge pieces may extend beyond the stem end as an axial extension of the valve actuator, being connected there to the threaded bolt. The wedge pieces then conically taper off with increasing distance from the gas exchange valve and are attached to the conical clamping sleeve via the thread formed on the threaded bolt.

The number of valve actuator components may be reduced due to the fact that the conical clamping sleeve is formed in one piece by the positioning piston and the threaded segment engages with a mating threaded segment on a radially inner peripheral surface of the positioning piston.

The threaded bolt may be connected to the wedge pieces in a particularly simple manner via annular bulges, peripherally situated on the wedge pieces and the threaded bolt, which engage in annular grooves.

Drawing

Exemplary embodiments of the present invention are illustrated in the drawing and explained in greater detail in the description that follows.

Fig. 1 shows a lateral cross section of a preferred embodiment of a valve actuator according to the present invention.

Fig. 2 shows a cross section along line II-II in Figure 1.

Fig. 3 shows a cross section along line III-III in Figure 1.

Detailed Description of the Exemplary Embodiment

Figure 1 shows a gas exchange valve 1 of a valve drive of an internal combustion engine, the gas exchange valve being operated by a positioning piston 2 of a valve actuator 4 in such a way that it performs upward and downward opening and closing movements in the axial direction.

Gas exchange valve 1 has, as is known, a valve stem 5, which extends in the axial direction away from the combustion chamber of the internal combustion engine. Valve stem 5 has a stem end 5a, distal from the combustion chamber, which is surrounded by two half-shell-shaped wedge pieces 6, 7. Stem end 5a has at least one annular groove 8, into which at least one annular bulge 9 formed on the inner periphery of wedge pieces 6, 7 engages radially. In the present example, a total of three axially equidistant annular grooves 8 on valve stem 5 and three mating annular

bulges 9 are provided. Annular bulges 9 are formed by essentially semicircular partial bulges on both wedge pieces 6, 7 which circularly complement one another, forming annular bulges 9.

Wedge pieces 6, 7 form on their outer peripheral surface a conically shaped segment 10, which tapers off with increasing distance from gas exchange valve 1. The two wedge pieces 6, 7 together form a clamping wedge 11, which cooperates with a mating conical inner surface 12 of a conical clamping sleeve 13. Conical clamping sleeve 13 is formed on an end 14 of positioning piston 2 proximal to the combustion chamber in one piece with the positioning piston.

Positioning piston 2 extends in the axial direction along an axis 15 concentrically to a longitudinal axis 17 of valve stem 5 of gas exchange valve 1. Valve actuator 4 has an actuator housing 20, which is axially traversed by positioning piston 2. A guide sleeve 18, within which positioning piston 2 is guided in its axial displacement via a guide collar 23 on positioning piston 2, is located in actuator housing 20. A first chamber 22, which is connected to a first pressure medium line (not illustrated in detail) via a first opening 21 in the wall of actuator housing 20, is formed in actuator housing 20 on the side of guide collar 23 facing the combustion chamber. First chamber 22 is delimited by actuator housing 20, guide sleeve 18 and positioning piston 2, including guide collar 23. A first sealing ring 26 prevents the pressure medium in first chamber 22, for example, hydraulic fluid, from escaping from actuator housing 20 via a first annular gap 24.

A second chamber 25, which is connected to a second pressure medium line (also not illustrated in detail) via a second opening 27 in the wall of actuator housing 20, is formed in actuator housing 20 on the side of guide collar 23 facing away from the combustion chamber. Second chamber 25 is also delimited by actuator housing 20, guide sleeve 18 and positioning piston 2, including guide collar 23. A second sealing ring 28 prevents the pressure medium in second chamber 25 from escaping from actuator housing 20 via a second annular gap 29.

Positioning piston 2 is designed in the form of a hollow cylinder. A constriction 38 on the inner periphery of positioning piston 2 is located between conical sleeve 13 proximal to the combustion chamber and an end 2a of positioning piston 2 distal from the combustion chamber. An inner thread 39 is formed in the area of constriction 38, which engages with a mating outer thread 40 on a threaded bolt 41. Threaded bolt 41 is situated concentrically within positioning piston 2. Outer thread 40 extends via a threaded segment 31 axially to threaded bolt 41 and engages, at least partially, with outer thread 40.

Threaded bolt 41 is axially connected to valve stem 5 in a form-fitting manner so it is able to rotate in the peripheral direction. For this purpose, conical clamping sleeve 13 and wedge pieces 6, 7 extend beyond stem end 5a of valve stem 5, surrounding end 41a of threaded bolt 41 proximal to the combustion chamber. At least one radial projection 42, which in the present example is designed as an annular bulge engaging radially in at least one depression 43 on the outer periphery of threaded bolt 41, is provided in the area of end 41a on the inner periphery of clamping wedge 11. Depression 43 is designed in the present example as an annular groove and there are a total of three axially equidistant bulges 42 situated on clamping wedge 11 and three mating grooves 43 on threaded bolt 41 which radially engage with bulges 42.

As is apparent from Figure 2, an end 41b of threaded bolt 41 distal from the combustion chamber is designed as an outer hexagon 45 for the application of a wrench (not illustrated). Threaded bolt 41 may be screwed into inner thread 39 using the wrench, clamping wedge 11 being axially and radially clamped to conical clamping sleeve 13 due to the form-fitting connection to clamping wedge 11. To prevent positioning piston 2 from being entrained by friction into rotation when threaded bolt 41 is screwed in, a second, also hexagonal, wrench may be used in a tool receptacle 46 on stem end 2a to secure it.

Figure 3 also shows that both wedge pieces 6, 7 rest radially in the shape of a half-shell on the conical clamping sleeve.

Against this background, the function of the valve actuator is the following:

Figure 1 shows gas exchange valve 1 in an open position, in which both chambers 22, 25 are pressurized via the pressure medium lines. Due to the smaller axial piston surface area of positioning piston 2 on first chamber 22, positioning piston 2 is axially offset with respect to the combustion chamber. Second chamber 25 is depressurized to close gas exchange valve 1; first chamber 22 always remains pressurized. Due to the overpressure in first chamber 22, positioning piston 2 is then moved upward toward second chamber 25.

To assemble valve actuator 4, gas exchange valve 1 is introduced into the valve stem guide of the cylinder head (not illustrated) and then wedge pieces 6, 7 are placed on stem end 5a. End 41a of threaded bolt 41 is also secured between wedge pieces 6, 7. Subsequently, valve actuator 4 is placed from above onto the pre-assembled components gas exchange valve 1, threaded bolt 41, and wedge pieces 6, 7 until the outer surface of clamping wedge 11 comes to rest on conical inner surface 11. A wrench is then positioned in positioning piston 2 on outer hex 45, and threaded bolt 41 is axially adjusted by rotating over thread 37, 39. In this way, clamping wedge 11 and conical clamping sleeve 13 are attached to each other. Positioning piston 2 may have to be secured in the direction of rotation using another tool.

The applicability of the present invention is not limited to the above-described exemplary embodiment. Thus, numerous modification options of the specific embodiment are conceivable, which do not essentially alter the inventive idea. Thus, positioning piston 2 may be installed more or less completely in actuator housing 20. The number of grooves 9, 43 and bulges 8, 42 may vary. The grooves and bulges may also be formed on another component without modifying the operating principle of the valve actuator. The points of application of the wrenches may be designed differently from the above-described embodiment.